

# Multimodal Displays

From visual and auditory displays to tactile, olfactory, and gustatory displays, there are many types of multimodal displays. Each type offers unique benefits and challenges for design.

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# Visual Displays

## **Images and graphics**

Easy to process; can quickly convey complex information. Ideal for displaying data and statistics.

## **Animations and videos**

Motion helps to engage users; useful for demonstrating processes and dynamic situations.

## **Visual cues and affordances**

Can guide users to interact with products or devices.

# Auditory Displays

1

**Sounds can alert users to changes in the environment.**

For instance, an alarm can signal a fire or emergency.

2

**Added layer of information**

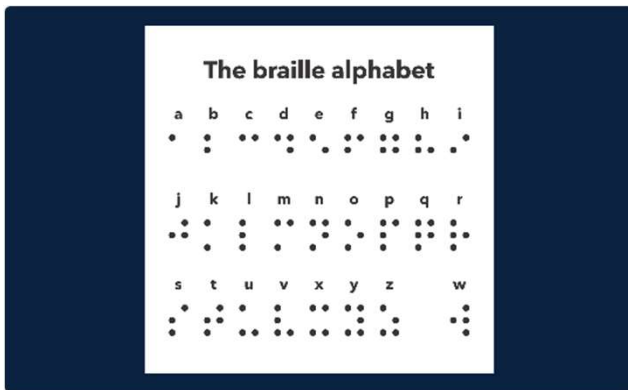
Auditory information can reinforce visual information, aiding the learning process.

3

**Sounds can evoke emotions**

Background music can support user experience and make some activities more enjoyable.

# Tactile Displays



## Braille displays

Provide an accessible way to read text for people who are blind.



## Touchscreens

Provide physical interaction with technology. Feedback can be provided through vibrations.



## Haptic feedback

Vibration patterns can be used to signal different types of information, making it an ideal tool for gaming and virtual reality experiences.

# Sensory Displays

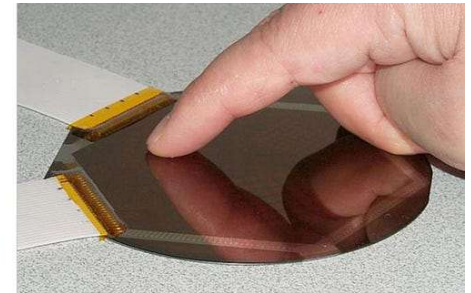
## Haptic Displays

- Provide touch feedback
- Used in gaming and virtual reality
- Create the illusion of texture and resistance



## Tactile Displays

- Provide pressure feedback
- Used in medical simulators and robotics
- Create the sensation of touch and force



## Tangible Displays

- Create physical objects that can be manipulated
- Used in educational settings and creative industries
- Bridge the gap between physical and digital experiences



# The Benefits of Sensory Displays

<b>Enhanced Experience:</b>	Sensory displays improve the overall quality and immersion of digital experiences.
<b>Better learning:</b>	Tactile and tangible displays improve the learning process by engaging the motor-sensory system.
<b>Medical Applications:</b>	Sensory displays can improve medical training, allowing for more realistic simulations for surgeries and other procedures.
<b>Business Potential:</b>	Sensory displays have the potential to revolutionize entertainment, advertising, and retail experiences.

# Olfactory and Gustatory Displays

1

## Olfactory

Certain scents, such as lavender, have calming effects or can help improve concentration. Could be used for aromatherapy or pair with VR experiences.

2

## Gustatory

Certain tastes can add realism to training simulations, especially ones dealing with food and drinks.

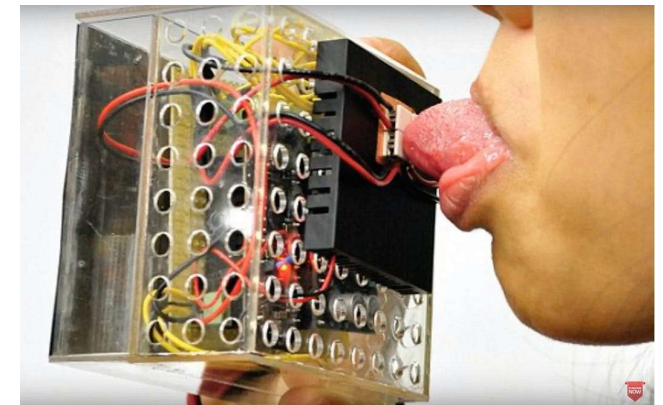
## Olfactory Displays: Smelling the Digital World

The nose has not been a prominent target for digital interaction until recently. Olfactory displays aim to simulate smells for a variety of applications, including enhancing gaming experiences and virtual tourism. By combining odors in novel ways, a large number of smell experiences can be created.



## Virtual Taste: Gustatory Displays

Gustatory displays reproduce the sensations of taste through electrical or thermal stimulation of the tongue and the release of certain flavors through liquid or vapor. From digital wine tastings to food pairings, gustatory displays have the potential to revolutionize the food and restaurant industries.





# Benefits of Using Multimodal Displays

**1**

## **Improved user experience**

The addition of multiple sensory cues can improve engagement and help people learn new tasks more efficiently.

**2**

## **Access for people with sensory disabilities**

Including sensory cues beyond beyond sight and hearing can make information accessible to more people, allowing for inclusivity.

**3**

## **Increased safety in hazardous environments**

Using multiple sensory cues can make it easier to stay safe in dangerous situations.



# Challenges of Designing Multimodal Displays



## Complexity and cognitive load

Integrating different types of sensory information can be cognitively demanding. Overloading users with too much information can decrease overall comprehension.



## Inclusivity

Designing for users with different sensory abilities requires additional care and attention, which adds complexity to the design process.

## Usability Testing 101

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NN/g



Uncover problems  
in the design



Discover opportunities  
to improve the design



Learn about user's  
behavior and preference

## Usability testing

Testing multimodal displays can be challenging, as it requires testing different sensory modalities in different user groups.

# Design Principles for Multimodal Displays

## Consistency

- Ensure all sensory cues are consistent with one another and provide the same information.
- Avoid mixing inconsistent sensory cues.

## Relevance

- Only include sensory cues that contribute to the task or experience.
- Avoid unnecessary or irrelevant cues.

## Clarity

- Make sure cues are easily distinguishable and easy to recognize.
- Avoid cues that are too similar or difficult to differentiate.



# Current Applications of Multimodal Displays

## Virtual Reality

Voice, touch, and vision enable more realistic experiences.

## Smart Homes

Voice and touch enable control over various devices such as thermostats, lights and alarms.

## Perceptual Wearables

Temperature control, lights and sounds could be affected.

## Automotive Perceived Quality

Displays uses realistic vibrations that increase haptic feedback and a stereo sound system designed to the vehicle's specific acoustics.

# Future Directions of Multimodal Displays

1

## Augmented Reality

Offers opportunities of creating interfaces that can use multiple sensory channels to present information in the most relevant or actionable manner.

2

## Sensor-based Data Collection Devices

The integration of sensors in devices could offer multimodal feedback that helps users to monitor their environment or health conditions.

3

## Education and Training

Cross-modal learning has proved as an important area of research that can span different areas of knowledge acquisition and training.



# Conclusion

Multimodal displays offer a rich and more engaging experience for users. Each sensory modality has its unique advantages and disadvantages for design. When creating multimodal displays, designers should consider which sensory modalities will best convey the task or experience's most relevant information. Multimodal displays may significantly impact various areas such as gaming, tourism, health care, educational and training settings, and wearable consumer electronics.